

Andasol

**The World's Largest
Solar Thermal Power Plant Project Development
in Andalusia (Spain)**



The Andasol Power Plants

The parabolic trough power plant Andasol 1, developed by Solar Millennium AG, is the first parabolic trough power plant in Europe. Andasol 1 will be capable of supplying environmentally-friendly solar electricity for up to 200,000 people. The power plant has started its test run in autumn 2008. The commissioning of Andasol 2 will follow in spring 2009 and Andasol 3 is scheduled for February 2011.

With a gross electricity output of around 180 GWh per power plant per year and a collector surface of over 510,000 square meters (equal to 70 soccer fields), the plants are the largest solar power plants in the world. Each power plant has an electricity output of 50 megawatts and operates with thermal storage. A full thermal reservoir can run the turbine for about 7.5 hours at full-load, in case it rains or long after the sunset. The heat reservoirs each comprise of two tanks measuring 14 m in height and 36 m in diameter and contain molten salt. Each holds 28,500 tons of storage medium.

The solar-thermal Andasol power plants are helping to meet peak demand in the Spanish power grid during the summer primarily caused by the high energy consumption of air conditioning units. The electricity supplied from the parabolic trough power plants is ideal for the electricity demand during the day, particularly early afternoon when the power demand reaches its peak and solar radiation as well as the power plant output are also at their peak.

At a glance – the data sheet of an Andasol power plant

<i>Electrical Capacity</i>	<i>50 Megawatt (MW)</i>
<i>Capital expenditure</i>	<i>~ 300 million Euro</i>
<i>Gross electricity output</i>	<i>~ 180 gigawatt hours per year (GWh/year)</i>
<i>Power plant dimension</i>	<i>2 square kilometres</i>
<i>Surface area of the collectors</i>	<i>> 510.000 square meters</i>
<i>Thermal storage system</i>	<i>28.500 tons of salt, sufficient for 7,5 hours at 50 MW power output</i>
<i>Solar power</i>	<i>to supply up to 200.000 people</i>
<i>Construction period</i>	<i>2 – 2,5 years</i>
<i>Number of employees during construction</i>	<i>up to 500</i>
<i>Number of employees when in service</i>	<i>about 40</i>



Construction site of Andasol 1 – 3 in April 2008

High security of energy supply through parabolic trough power plants

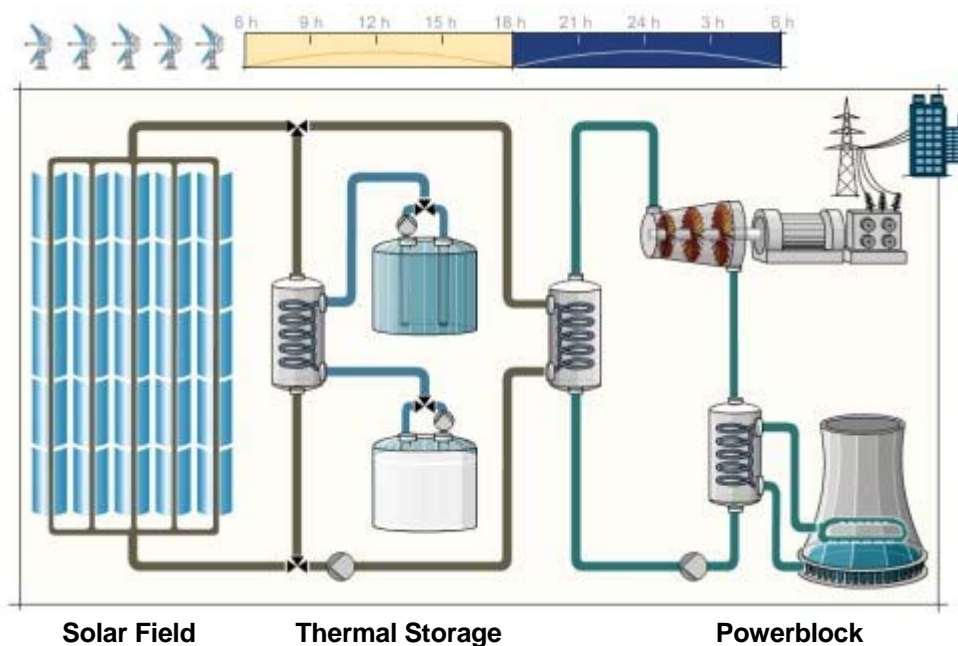
Solar-thermal power plants generate electricity using the heat captured from solar radiation. In a parabolic trough power plant, trough-shaped mirrors focus the incident solar radiation onto a pipe in the focal line of the collector. A heat transfer medium in the pipe is heated, and this generates steam in the power block section using heat exchangers. The steam is then used to operate a turbine which generates electricity in the same way as conventional power plants. This allows the solar energy to be utilized in an efficient and economical manner. Parabolic trough power plants are a recognized and reliable technology and have been in commercial use in California for more than 20 years.



The core of the parabolic trough plant: the solar field with the solar collectors and the absorber tube (here: Solar Millennium Demonstration project at a power plant in California)

It is possible to provide electricity when it is required using liquid salt tanks for thermal storage. The thermal storage in the Andasol power plants enables them to continue to run the turbine for about 7.5 hours at full-load.

Power plant configuration of a parabolic trough power plant



The parabolic trough power plant Andasol 1

Located on the Guadix plateau in the Spanish province of Granada, Andasol 1 has started its test run in autumn 2008. The power plant project has been developed by Solar Millennium AG, Erlangen (Germany). The corporation concluded a partnership for the construction of the power plant with the ACS/Cobra group, Spain's largest construction and plant engineering company, which in December 2004 entered into the 300 million Euro project by purchasing shares of the company Andasol 1 S.A. and which holds 75 percent of the shares today. Using the experience of Solar Millennium, the ACS/Cobra group is responsible for constructing the power plant; Flagsol GmbH, the technology subsidiary of Solar Millennium AG, provides the engineering for the solar field, i.e. planning, design and construction monitoring, as well as the controls of the solar field.

The parabolic trough power plant Andasol 2

Construction of the solar power plant Andasol 2 started in the beginning of 2007. Andasol 2 is identical in dimension with Andasol 1. ACS/Cobra, which is responsible for the construction of the power plant, entered also in this project holding 75 percent of the shares today. 25 percent of the shares are in ownership of Solar Millennium Verwaltungs GmbH, a subsidiary of Solar Millennium AG.

The parabolic trough power plant Andasol 3

The Andasol 3 solar-thermal power plant is the third project that Solar Millennium has developed in the Granada province in southern Spain. Andasol 3 is identical in dimension with Andasol 1 and 2. Construction of Andasol 3 started with the commissioning of the early works in August 2008 and is planned to be finished in February 2011. Solar Millennium AG holds 50 percent of the shares of the project company Marquesado Solar S.A.. The subsidiary Solar Millennium Beteiligungen GmbH holds the remaining 50 percent of the shares.



Location of the Andasol sites

Positive Market Outlook for Solar-Thermal Power Generation

Today the political framework in Spain allows power plant projects to be put into operation, with energy supply payments for solar-thermal electricity, which is guaranteed by law for 25 years. Solar thermally-generated electricity is currently remunerated with a feed-in tariff of just under €0.27/kWh. However, with its large potential for cost reduction, solar-thermal power generation technology will, according to the world market initiative for solar-thermal electricity, probably be able to compete with peak and normal load electricity from fossil energy sources even within ten years. The increasing power plant capacity is common sense: the International Energy Agency (IEA) as well as Greenpeace and the US Department of Energy forecast a capacity of at least 20,000 Megawatt. Greenpeace and the European Renewable Energy Council (EREC) forecast 267,000 Megawatt by 2040.

The German Aerospace Center, DLR, assumes that by 2050 renewable energies will largely have superseded fossil energies in Mediterranean countries and that solar-thermal power plants will be able to deliver twice as much electricity as wind, photovoltaic, biomass and geothermal power plants together. The German Physical Society, DPG, and the Club of Rome recommend importing solar-thermal electricity from the Mediterranean to Germany.

For current studies and internet links please visit

http://www.solarmillennium.de/Energy_Market/Studies_and_Predictions/Studies_on_Solar_Thermal_Power_Generation_lang2,30.html

Solar Millennium AG

Solar Millennium AG is a globally active company in the renewable energy sector with its main focus on solar thermal power plants. Together with its subsidiaries, Solar Millennium has specialized in parabolic trough power plants, a proven and future-oriented technology in which the company plays a leading role worldwide. Solar Millennium covers all of the important business sectors within the value-added chain of solar thermal power plants, from the project development to the technology, from the turn-key construction of the plants to the operation and ownership of power plants.

Solar Millennium has developed Europe's first parabolic trough power plants in Spain. Two of the plants are under construction. Further projects with a capacity of several hundred megawatts are currently being planned worldwide, with the focus on Spain, the United States, China and North Africa. The company is also developing solar chimney power plants with the aim of making this technology ready for the market.



Locations of Solar Millennium AG